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Damasia DM
Assistant Professor, College of Agriculture, Navsari Agricultural University, Waghai, Dist- The Dangs, Gujarat, India

Patel ZP
Dean and Principal, College of Agriculture, Navsari Agricultural University, Waghai, Dist- The Dangs, Gujarat, India

Bambharolia RP
Assistant Professor, College of Agriculture, Navsari Agricultural University, Waghai, Dist- The Dangs, Gujarat, India

Corresponding Author:
Damasia DM
Assistant Professor, College of Agriculture, Navsari Agricultural University, Waghai, Dist- The Dangs, Gujarat, India

Effect of abiotic factors on seasonal incidence of tea mosquito bug, *Helopeltis antonii* Signoret of cashew in South Gujarat

Damasia DM, Patel ZP and Bambharolia RP

Abstract
A study was carried out on cashew variety Vengurla-4 at farmer's field in hilly area of the Dangs district, Gujarat, India during 2017-18 and 2018-19 to investigate the relationship of pest incidence with abiotic factors like temperature, humidity, sunshine, wind speed and evaporation. Regular weekly observations were recorded on the population and damage of tea mosquito bug from thirteen leader shoots in each direction (East, West, North and South) on three randomly selected trees. The meteorological data was collected for the study from meteorological observatory located at Hill Millet Research Station, Waghai, the Dangs, Gujarat for the period of two years. The activity of tea mosquito bug was initiated in the month of October. Thereafter, population and damage found increasing and it was maximum during January-February. After the month of February, the population went on decreasing slowly and almost absent by the end of April. Tea mosquito bug population and damage showed significant negative correlation with maximum temperature, minimum temperature and mean temperature.

Keywords: Abiotic factors, cashew, seasonal incidence, tea mosquito bug

Introduction
Cashew (*Anacardium occidentale* L.) is the crop that, converts waste lands into goldmine, is subjected to be attacked by a number of insect pests with varying degree of incidence. As many as 133 arthropod pests are known to cause damage of the crop (Rai, 1984) [11]. Among these, the tea mosquito bug alone has a potential to cause 30 to 50 per cent yield loss in cashew (Abraham and Nair, 1981) [1].

Three species of tea mosquito bug, *viz.*, *Helopeltis antonii* Signoret, *Helopeltis bradyi* Waterhouse and *Helopeltis theivora* Waterhouse are found in India. Among them, *H. antonii* is the dominant species (Sundararaju, 1996) [14]. In early records, these pests especially in tea commonly called as 'tea bug' and 'tea mosquito' and the damage was reported as 'tea blight', 'mosquito blight' and 'spot blight'. The same common terminologies are in usage even now (Bhat, 2015) [3].

The population of TMB reaches its peak during flushing, flowering and fruiting season in cashew, *i.e.* from November to February. Both nymphs and adults suck sap from tender shoots and leaves, floral branches and from developing nuts and apples by making a number of feeding lesions. They feed by sucking the plant parts injecting poly-phenoloxydase from their salivary glands (Mandal, 2000) [9]. Typical feeding damage by *Helopeltis* spp. appears as a discoloured necrotic area or a lesion around the point of entry of the labial stylets inside the plant tissue. The infestation of inflorescence results in "blossom blight". Each insect can damage 3 to 4 shoots or panicles leading to heavy loss in yield (Devasashayam and Nair, 1986) [5].

Recently, much of the emphases are being given on sustainable agriculture based on suitable integrated pest management strategies. Hence, knowledge of pest population ecology is essential for appropriate control strategies. Further, the pest's interaction with abiotic factors helps in planning need based application of insecticides, as it clearly reveals the insects peak activity periods during the crop growth. Hence, information on seasonal incidence and influence of weather on development of pests is of prime importance for forecasting the incidence of pests in a particular region.

Materials and Methods

A field experiment was conducted during 2017-18 and 2018-19 on cashew variety Vengurla-4 at farmer's field in hilly area of the Dangs, Gujarat. The incidence of tea mosquito bug in cashew ecosystem was studied in relation to weather parameters. The observation on incidence of tea mosquito bug of cashew was recorded throughout the year at weekly interval. For recording the observations, three cashew trees were selected randomly from experimental plot area. The whole experimental plot was kept free from any insecticide application.

Thirteen leader shoots in each direction (East, West, North and South) on three randomly selected trees were observed for the number of nymphs and adults. Total number of shoots (Non-flowering lateral) and panicles (flowering laterals) were recorded separately in above area. The extent of damage to the shoots and panicles were scored on a 0-4 scale on the basis of the number and nature of necrotic lesion (Ambika *et al*., 1979) [2] as given below.

0	No damage
1	1 to 3 necrotic streaks/lesions on the shoot/panicle including apple and nut
2	4 to 6 coalescing or non-coalescing lesions/streaks on the shoot/panicle including apple and nut
3	Above six coalescing or non-coalescing lesions/streaks on the shoot/panicle including apple and nut
4	Lesion/streaks confluent or wilting or drying of affected shoot /panicle including apple and nut

The recoded data converted in to mean score value on the basis of formula given below,

$$\text{Mean score value} = \frac{\text{Total score}}{\text{Total number of lateral shoots + Panicles}}$$

With a view to study the impact of different weather parameters on pest incidence, a simple correlation between pest population/damage and weather parameters were worked out.

Results and Discussion

The result presented in Table 1 revealed that, the population of tea mosquito bug prevailed only from October to April, while it remained absent from May to September under field condition in hilly area of the Dangs. The data further indicated that, it ranged from 0.02 to 0.46 bugs with an average of 0.21 bugs per leader shoot throughout its occurrence during the year 2017-18. Moreover, the population started building up from October and subsequently found increasing and reached to a peak (0.46 bugs/leader shoot) in the month of January 4th standard meteorological week (SMW). Thereafter, it was slowly declining and remained absent during May to September including monsoon period. Similarly, the damage caused by tea mosquito bug was ranged from 0.03 to 1.82 with an average 0.84 scale/shoot during the year 2017-18. The damage (0.05 scale/shoot) was recorded from November 44th SMW to April 16th SMW and as high as 1.82 damage scale was recorded in February 5th SMW.

Almost similar pattern of population of tea mosquito bug was observed in the year 2018-19. It was ranged from 0.02 to 0.42 with an average of 0.18 bugs per leader shoot. As high as 0.42 bugs per leader shoot was recorded in the month of January 3rd SMW during the period under report. Similarly, the damage caused by tea mosquito bug was ranged from 0.02 to 1.62 with an average 0.72 scale/shoot during the year 2018-19. The damage (0.03 scale/shoot) was recorded from November 44th SMW to April 16th SMW. As high as 1.62 damage scale was recorded in February 5th SMW.

Likewise, same trend of population of tea mosquito bug was apparently observed from the average data of two years (2017-18 and 2018-19). As mentioned individually for two years, the average population was ranged from 0.01 to 0.43 bugs with an average of 0.19 bugs per leader shoot. Similarly, the average damage was ranged from 0.03 to 1.72 scale/shoot with an average of 0.78 scale/shoot.

Average data of two years on population clearly indicated that, the activity of tea mosquito bug was initiated after monsoon *i.e.* in the month of October in hilly area of the Dangs. It was well coincided with arrival of new flush of shoots which is most suitable to suck the cell sap from new leaves by tea mosquito bug. Thereafter, population found increasing and it was maximum during January-February during which ample flowers, tender nuts and apples are made available to the nymphs and adults of tea mosquito bug for sucking cell sap. After the month of February, the population went on decreasing slowly and almost absent by the end of April.

Table 1: Incidence of tea mosquito bug in cashew during 2017-18 and 2018-19

Month and week		SMW	Number of bug/leader shoot			Damage scale/lateral		
			2017-18	2018-19	Average	2017-18	2018-19	Average
October	IV	43	0.02	0.00	0.01	0.00	0.00	0.00
November	I	44	0.06	0.04	0.04	0.05	0.03	0.04
	II	45	0.15	0.02	0.09	0.25	0.04	0.15
	III	46	0.12	0.04	0.08	0.53	0.38	0.46
	IV	47	0.10	0.10	0.10	0.50	0.60	0.55
December	I	48	0.19	0.08	0.14	0.59	0.72	0.66
	II	49	0.29	0.12	0.21	0.86	0.78	0.82
	III	50	0.21	0.15	0.18	1.02	0.92	0.97
	IV	51	0.35	0.23	0.29	1.20	1.00	1.10
	V	52	0.32	0.25	0.29	1.38	1.03	1.21
January	I	1	0.40	0.31	0.36	1.45	1.14	1.30
	II	2	0.44	0.38	0.41	1.62	1.09	1.36
	III	3	0.33	0.42	0.38	1.68	1.25	1.47
	IV	4	0.46	0.40	0.43	1.72	1.54	1.63
February	I	5	0.40	0.37	0.39	1.82	1.62	1.72
	II	6	0.35	0.40	0.38	1.75	1.60	1.68
	III	7	0.37	0.33	0.35	1.12	1.25	1.19

	IV	8	0.29	0.21	0.25	1.26	1.06	1.16
March	I	9	0.17	0.19	0.18	0.95	1.00	0.98
	II	10	0.17	0.15	0.16	0.78	0.62	0.70
	III	11	0.10	0.15	0.13	0.49	0.39	0.44
	IV	12	0.13	0.08	0.11	0.31	0.32	0.32
April	I	13	0.04	0.10	0.07	0.18	0.10	0.14
	II	14	0.06	0.02	0.04	0.14	0.09	0.12
	III	15	0.02	0.04	0.03	0.07	0.09	0.08
	IV	16	0.00	0.02	0.01	0.03	0.02	0.03
Not appeared during May to September								
Mean			0.21	0.18	0.19	0.84	0.72	0.78

The findings on population dynamics as well as damage intensity are in concurrence with those of Naik *et al.* (2012) [10] as well as Khan and Hiremath (1986) [8] from Karnataka, Sundararaju (1984) [13] from Goa. It is also indicative from the available literature that, the tea mosquito bug incidence and damage was exists between October to May with maximum during January - February in various cashew growing area of the country. It was observed by Jalgaonkar *et al.* (2015) [6] as well as Zote *et al.* (2017) [15] in Maharashtra, Sahu *et al.* (2015) [12] in Chhattisgarh and Kar and Poduval (2016) [7] in West Bengal. Thus, the above reports made by various scientists strongly support the present findings.

Effect of abiotic factors on tea mosquito bug incidence

The close perusal of data of correlation between abiotic factors and population of tea mosquito bug (Table 2) showed that maximum temperature, minimum temperature and mean temperature had significantly negative impact on population build up of tea mosquito bug during 2017-18 whereas, other tested abiotic factors did not exert pressure on population built up of tea mosquito bug. Similarly, tea mosquito bug damage exhibited significantly negative association with maximum temperature, minimum temperature and mean temperature.

Almost similar association was observed between abiotic factors and population of tea mosquito bug recorded during 2018-19 (Table 2). It was indicated significantly negative impact of maximum temperature, minimum temperature and mean temperature on the activity of tea mosquito bug, while significant positive correlation was observed between tea mosquito bug population and wind speed. Furthermore, tea mosquito bug damage was showed significantly negative relationship with maximum temperature, minimum temperature and mean temperature.

Exactly similar relationship was obtained between average data of two years (2017-18 and 2018-19) on abiotic factors and tea mosquito bug population. It was revealed significantly negative correlation between maximum temperature, minimum temperature and mean temperature with tea mosquito bug population, while other parameters did not showed any influence on the activity of tea mosquito bug. In the same way, tea mosquito bug damage exhibited significantly negative association with maximum temperature, minimum temperature and mean temperature (Table 2).

Table 2: Correlation between abiotic factors and tea mosquito bug infesting cashew during 2017-18 and 2018-19

Weather Parameters	Tea mosquito bug					
	Number of bug/leader shoot			Damage scale/lateral		
	2017-18	2018-19	Average	2017-18	2018-19	Average
Max T (^{O}C)	-0.631**	-0.439*	-0.523**	-0.536**	-0.508**	-0.591**
Min T (^{O}C)	-0.819**	-0.860**	-0.891**	-0.792**	-0.761**	-0.859**
Mean T (^{O}C)	-0.810**	-0.680**	-0.777**	-0.743**	-0.708**	-0.815**
Morning RH(%)	0.286	-0.151	0.134	0.273	0.001	0.166
Evening RH (%)	0.067	-0.053	0.150	0.019	0.190	0.214
Mean RH (%)	0.192	-0.117	0.153	0.153	0.090	0.200
BSSH (hr/day)	0.180	0.337	0.184	0.125	0.274	0.165
WS (km/hr)	-0.015	0.401*	0.183	-0.129	0.368	0.188
EP (mm/day)	-0.175	-0.249	-0.330	-0.272	-0.264	-0.374
* Significant at 5% level of significance ** Significant at 1% level of significance						

The above data of negative significant correlation of population of tea mosquito bug as well as damage with maximum temperature is matched with Kar and Poduval (2016) [7] in West Bengal. In case of minimum temperature significantly negative correlation was observed in the findings of Chakraborti and Majumder (2007) [4] in West Bengal, Jalgaonkar *et al.* (2015) [6] as well as Zote *et al.* (2017) [15] in Maharashtra and Kar and Poduval (2016) [7] in West Bengal, which are closely similar with the results of present study.

Conclusion

From the present study, it is concluded that, the incidence of tea mosquito bug in cashew was started in the month of October when there was emergence of new flush on the tree and was maximum incidence in the month of January-February, when tree was in flowering and fruiting stage. Tea mosquito bug population and damage showed significant negative correlation with maximum temperature, minimum temperature and mean temperature. All other weather parameters did not showed any significant influence on the activity of tea mosquito bug.

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